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In the Supreme Court of the United States

OCTOBER TERM, 1979

SIDNEY A. DIAMOND, COMMISSIONER OF PATENTS AND TRADEMARKS, PETITIONER

v.

JOHN J. BRADLEY AND BENJAMIN S. FRANKLIN

PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF CUSTOMS AND PATENT APPEALS

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PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF CUSTOMS AND PATENT APPEALS

The Solicitor General, on behalf of the Commissioner of Patents and Trademarks, petitions for a writ of certiorari to review the judgment of the United States Court of Customs and Patent Appeals in this case.

OPINIONS BELOW

The opinion of the Court of Customs and Patent Appeals (App. A, *infra*, 1a-15a) is reported at 600 F.2d 807. The opinion of the Patent and Trademark Office Board of Appeals (App. C, *infra*, 17a-30a) and the opinions of the patent examiner (App. D, *infra*, 31a-41a) are not reported.

JURISDICTION

The judgment of the Court of Customs and Patent Appeals was entered on July 5, 1979 (App. B, *infra*, 16a). On October 2, 1979, the Chief Justice extended the time to file a petition for a writ of certiorari to and including December 2, 1979. The jurisdiction of this Court is invoked under 28 U.S.C. 1256. *Gottschalk* v. *Benson*, 409 U.S. 63 (1972); *Dann* v. *Johnson*, 425 U.S. 219 (1976).

QUESTION PRESENTED

Whether a computer program that regulates the internal operation of a computer is patentable subject matter under 35 U.S.C. 101.

STATUTE INVOLVED

35 U.S.C. 101 provides:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

STATEMENT

On April 21, 1975, John J. Bradley and Benjamin S. Franklin applied for a patent (App. E, *infra*, 42a-51a) on an invention that directs the transfer of data within a computer.[1]

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[1] The invention is assigned to Honeywell Information Systems, Inc. Brief for Appellants at 2.

The computer's hardware [2] includes a main memory which has a system base [3] with which the computer programmer can communicate.[4] In high performance computers, where speed of operation is important, certain information that is part of the system base may be stored in storage components of the computer called "scratchpad registers" (App. A, *infra*, 2a & n.1). Because these registers are not, however, normally accessible to the programmer by means of com-

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[2] The physical components of the computer are called "hardware." *Honeywell, Inc.* v. *Lithonia Lighting, Inc.*, 317 F.Supp. 406, 408 (N.D. Ga. 1970); Ross, *The Patentability of Computer "Firmware,"* 59 J. Pat. Off. Soc'y 731, 736 (1977).

[3] The system base controls the operation of the computer; it contains the process information used by the computer to carry out programmed operations.

[4] A programmer wanting a general purpose computer to perform a certain assigned task communicates with the computer by translating the task into coded instructions that can be read, understood and executed by the computer system. These instructions, called a "program," are written by the programmer in special programming language, such as COBOL or FORTRAN. See C. Sippl & C. Sippl, *Computer Dictionary and Handbook* 80, 191 (2d ed. 1972); *In re Ghiron*, 442 F.2d 985, 986 (C.C.P.A. 1971); *In re Waldbaum*, 457 F.2d 997, 998 (C.C.P.A. 1972). Computer programs as well as the information (data) fed into the computer are commonly called "software." *Honeywell, Inc.* v. *Lithonia Lighting, Inc., supra*, 317 F.Supp. at 408; Ross, *supra*, 59 J. Pat. Off. Soc'y at 736. Computer users either write their own programs or obtain them from software vendors. In 1978, user expenditures for software products amounted to $981 million. Cunningham & Smith, "Computer Services: A Menu of Options," Datamation 89, 91 (May 25, 1979).

puter programs (App. A, *infra*, 3a), changing the data they contain has been a problem.[5]

Bradley's claimed invention provides an improved method for changing the data in the registers. In addition to certain hardware elements, it employs "firmware" (*ibid.*). Firmware consists of a sequence of basic instructions stored as a microprogram in the computer's control memory.[6] When activated by software, the instructions cause a particular sequence

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[5] To change the data in the scratchpad registers the programmer has had to reprogram the entire system base, a time consuming task, or use software limited to that particular computer model, an option unacceptable to many computer users (App. A, *infra*, 3a; App. C, *infra*, 18a-19a).

[6] A microprogram has been defined as "a sequence of elementary steps which permits the computer hardware to carry out a program instruction." Ross, *supra*, 59 J. Pat. Off. Soc'y at 754, quoting from P. Jordain & M. Breslau, *Condensed Computer Encyclopedia* 318 (1969). Thus, the microprogrammer, like the programmer, uses special programming language to prepare instruction for the computer to carry out in sequence. Ross, *supra*, 59 J. Pat. Off. Soc'y at 765. The microprogram is usually stored in a "control memory" physically separate from other computer memories. *Id.* at 758. Early control memories were of the "read only" variety (ROM) which meant that the microprogram was physically fixed in the control memory by the manufacturer. To change the microprogram the manufacturer had to install a new ROM with the new microprogram. Technical advances made it possible for the user himself to microprogram the control memory (programmable read only memory, PROM). Although the original PROMs could be programmed only once, many large computers now have a "read-write" PROM, which permits the user to reprogram the control memory any number of times electrically. *Id.* at 760-761.

of computer operations to take place.[7] An instruction in the firmware developed by Bradley permits the programmer to communicate with the scratchpad registers and to switch data back and forth from the registers to the system base in the main memory (App. C, *infra*, 19a).[8]

The patent examiner rejected the invention as drawn to nonstatutory subject matter under 35 U.S.C. 101 (App. D, *infra*, 34a, 37a). He noted that the hardware arrangement to which the claims referred —"a main memory, central processing unit, and scratchpad registers"—were "wellknown components" that were "admittedly old in the art * * *" (*id.* at 38a).[9] He found that the only novel aspect

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[7] Bradley's firmware is stored in a control memory of the PROM type, which can be microprogrammed by the user (App. E, *infra*, 45a-46a). The record does not clearly indicate which type of PROM is involved, although Bradley does state that the PROM can be "reloaded" (*id.* at 45a).

[8] When the programmer activates what Bradley calls a "switch system base instruction," this initiates the execution of a microprogram that transfers the data (App. C, *infra*, 19a). In Bradley's specification, the switch system base instruction is disclosed by the diagram in Figure 15a (App. E, *infra*, 48a) and the microprogram steps are disclosed in the flow charts of Figures 15b and 15c (*ibid.*).

[9] The examiner further noted in his answer before the Patent and Trademark Office Board of Appeals that microprogrammed control units like Bradley's were also old in the art (App. C, *infra*, 23a). Thus, he concluded that the invention "resides in an instruction in firmware which changes upon execution, information in the system base" (*ibid.*).

of the invention resided in an algorithm [10] designed to control the multiprogramming computer to solve the particular problem indicated (App. D, *infra*, 38a-39a). He concluded that this "program implemented algorithm" was not patentable under *Gottschalk* v. *Benson*, 409 U.S. 63 (1972) (*id.* at 39a).

The Patent and Trademark Office Board of Appeals ("Board") agreed with the examiner (App. C, *infra*, 17a-30a). It found that "save for the microprogramming" Bradley's arrangement of hardware was old in the art (*id.* at 26a-27a). It ruled that the fact that Bradley's claims were in "apparatus," rather than "methods," format did not make them any less "related to an algorithm" than was the claim in *Benson* (*id.* at 28a-29a).[11] Added the Board, "[a] claim for an improved method of calculation, even when tied to a specific end use, is unpatentable" under *Parker* v. *Flook*, 437 U.S. 584 (1978) (*id.* at 29a-30a). The Board concluded that Bradley's claimed invention con-

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[10] In computer terminology, an algorithm has been defined as follows:

> 1. A fixed step-by-step procedure for accomplishing a given result; usually a simplified procedure for solving a complex problem, also a full statement of a finite number of steps. 2. A defined process or set of rules that leads and assures development of a desired output from a given input. A sequence of formulas and/or algebraic/logical steps to calculate or determine a given task; processing rules.

C. Sippl & C. Sippl, *supra*, at 23.

[11] Thus, the claims "recite[d] apparatus as a matter of form only" (*id.* at 30a).

sists of apparatus that is old in the art coupled with "programming, which is nonstatutory" under *Benson* and *Flook* (App. C, *infra*, 30a).

The Court of Customs and Patent Appeals ("CCPA") reversed. It observed that Bradley was claiming "a machine or apparatus" composed of a "combination of hardware elements" which fell "literally within the boundaries of § 101" (App. A, *infra*, 12a). The court recognized that this "combination" also involves "a portion of the computer's control store microprogrammed in a particular manner." It left standing the Board's determination that the apparatus was old in the art and that only the microprogram was new (*id.* at 13a), but it rejected the Board's "distillation of [the] claim down to the information contained in the firmware * * *" (*id.* at 14a). The proper analysis, said the court, involves determining "whether the claim recites a mathematical algorithm, and, if so, whether it preempts the use of the algorithm" (*ibid.*). Applying this test, it stated that there was no mathematical algorithm here (*ibid.*). Although certain calculations were made, they did not "transform the invention as a whole into a method of calculation" because, after the invention's task was completed, there was not present a "solution of an equation, such as the new alarm limit in *Flook*, or the equivalent pure binary number, as in *Benson* * * *" (*id.* at 14a-15a).

REASONS FOR GRANTING THE PETITION

In concluding that Bradley's invention is patentable subject matter under 35 U.S.C. 101, the Court of Customs and Patent Appeals refused to apply the analysis of the claims required under *Parker* v. *Flook*, 437 U.S. 584 (1978), read too narrowly this Court's decision in *Gottschalk* v. *Benson*, 409 U.S. 63 (1972), and thus significantly extended coverage of the patent laws without legislative authorization.

1. This Court's decision in *Parker* v. *Flook*, 437 U.S. 584 (1978), requires that a patent claim involving an algorithm be analyzed under Section 101 in two steps. First, one must determine whether the claim contains a principle, formula, idea or concept which, as one of the "basic tools of scientific and technological work," is itself unpatentable and must be separated from the rest of the claim. *Id.* at 591-594. Second, what remains of the claim must then be analyzed to determine whether it is old in the art. *Id.* at 594-595.

The Board of Appeals followed this method of analysis, found that everything in Bradley's claim was old in the art except the programmed algorithm, and held the algorithm itself was not patentable. The court below, however, adhered to the approach it had developed in pre-*Flook* cases (App. A, *infra*, 10a; see also *In re Flook*, 559 F.2d 21 (C.C.P.A. 1977)). It did not dispute the Board's findings that everything in Bradley's claim was old except the program [12]

[12] Bradley had claimed that this finding was erroneous. This is surprising, since Bradley's arrangement of computer hardware incorporated by reference an earlier application

and that the program expressed an algorithm (App. A, *infra*, 13a-14a). It nonetheless rejected the Board's analysis as involving a "distillation of appellants' claim down to the information contained in the firmware * * *" (*id.* at 14a). It insisted that, since Bradley had drafted the claim as one for an an arrangement of hardware, it must be so regarded "as a whole" and involved neither a "mathematical algorithm" nor "calculations" which transform the invention "into a method of calculation" (*ibid.*).

The CCPA's analysis is squarely at odds with *Flook*.[13] What the court labelled an inappropriate "distillation" of Bradley's claim is precisely the kind of two-step analysis that this Court mandated in *Flook*. The lower court's insistence upon discarding that analysis for reliance on the inventor's characterization of his claim as an arrangement of hardware makes patentability turn on the skill of the draftsman and would "ill serve the principles underlying the prohibition against patents for 'ideas' or

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for a system base admittedly invented by Claude Carre and others (App. E, *infra*, 42a, 47a). The Carre drawings disclose an arrangement of hardware identical to Bradley's. Thus, 21 of Bradley's 22 sheets of drawings are identical to Carre's. Compare Bradley's summary of the drawings, Figures 1-14i (App. E, *infra*, 43a-44a) with Carre's summary of Figures 1-14i (App. F, *infra*, 52a-53a). Only Bradley's algorithm is new. The court below avoided this issue (App. A, *infra*, 12a).

[13] This is not the first time that that court has rejected *Flook*. See *In re Bergy*, 596 F.2d 952, 962-964, 966 (C.C.P.A. 1979), cert. granted, No. 79-136 (Oct. 29, 1979). See also pages 12-13, *infra*.

phenomena of nature." *Flook*, *supra*, 437 U.S. at 593. Bradley's claim, however artfully described, seeks a patent on an algorithm,[14] for everything else in his claim is old and not his inventive contribution.[15] Finally, the court's reference to the claim "as a whole" fails to focus on the algorithm itself, as required by *Flook*, and reflects instead the approach of the dissent in *Flook*, *supra*, 437 U.S. at 599-600.

The court compounded these errors by assuming that, so long as the algorithm was not mathematical, its patentability under Section 101 posed no problems (App. A, *infra*, 7a-11a, 14a). Undoubtedly, a claim whose only novel element is a computer program expressing a mathematical algorithm is not patentable subject matter. *Benson* and *Flook* make that clear. But although the algorithms in *Flook* and *Benson* were mathematical, the Court's holdings did not rest on any distinction between mathematical and non-mathematical algorithms. The Court broadly stated in *Benson* that "[p]henomena of nature, though just discovered, mental processes, and abstract intellectual

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[14] Bradley's abstract of disclosure makes this plain:

> A model-independent instruction in firmware is provided to change, upon execution, information in the system base which is located in both main memory and internal scratch pad registers.

App. E, *infra*, 42a.

[15] Thus the lower court's statement that "[i]f appellants were claiming the information embodied in the firmware or the firmware itself, per se, a different case would be presented [and that] [w]e express no opinion on the statutory nature of such an invention * * *" (App. A, *infra*, 13a) blinks reality.

concepts are not patentable, as they are the basic tools of scientific and technological work." 409 U.S. at 67. The Court in *Flook* had the same broad focus when it stated that "[d]ifficult questions of policy concerning the kinds of programs that may be appropriate for patent protection and the form and duration of such protection can be answered by Congress on the basis of current empirical data not equally available to this tribunal." 437 U.S. at 595 (footnote omitted).

Phenomena of nature, mental processes and abstract intellectual concepts may be mathematical, but they need not be. Indeed, most ideas and concepts are not mathematical, yet the absence of mathematical expression does not make them any more the subject of the patent laws. The phenomena that water runs downhill and that the sun rises in the east are no more patentable than mathematical equations. Cf. *Eibel Process Co.* v. *Minnesota & Ontario Paper Co.*, 261 U.S. at 45 (1923), cited in *Parker* v. *Flook*, *supra*, 437 U.S. at 590 n.12.

So it is with computer programs.[16] The proper inquiry is whether the program, be it mathematical

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[16] The fact that Bradley's program is firmware rather than classic software is immaterial. As the CCPA noted, firmware "may be likened to software * * *" (App. A, *infra*, 13a). This particular firmware can be programmed by the user (App. E, *infra*, 45a-46a; note 7, *supra*). But even if the program were permanently built into the machine, this would not be a matter of particular significance, as the CCPA has elsewhere recognized. See *In re Maucorps*, No. 79-554 (C.C.P.A. Nov. 1, 1979), 453 Pat. T.M. & Copyright J. (BNA) A-1 (Nov. 8, 1979).

or nonmathematical, expresses a phenomenon of nature, mental process, or an abstract intellectual concept. Bradley's program, when measured against this standard, is no more patentable than the algorithms involved in *Benson* and *Flook*. Like programs generally, Bradley's program is a set of directions to the computer. It commands the switching of data, of whatever type, untied to any particular end use. Although the directions are for the movement of information in the computer system base, they as much reflect abstract intellectual concepts as directions for the translation of texts from Russian to English (*In re Toma*, 575 F.2d 872 (C.C.P.A. 1978)) or for a hitherto unknown and faster route between Washington and New York. The computer programmer simply uses the computer to implement the idea embodied in the program. See *Benson*, *supra*, 409 U.S. at 67; *O'Reilly* v. *Morse*, 56 U.S. (15 How.) 62, 112-113 (1853).

2. The importance of this case transcends its particular facts and the lower court's evident unwillingness to apply *Parker* v. *Flook*. That unwillingness is confirmed by a number of other cases in which the CCPA has similarly adhered to the analysis of the dissent in *Flook*, rather than the opinion of the Court. *In re Gelnovatch*, 595 F.2d 32, 36-37 (1979); *In re Johnson*, 589 F.2d 1070, 1081 (1978); *In re Sarkar*, 588 F.2d 1330, 1332-1333 (1979). The CCPA's interpretation of *Benson* and *Flook* is highlighted in

In re Diehr, 602 F.2d 982 (C.C.P.A. 1979), reh. denied (Oct. 18, 1979), a case involving a mathematical algorithm similar to the one involved in *Flook*. We plan to file a petition for a writ of certiorari in *Diehr* shortly. We suggest that it be considered with this case, and that it would be desirable for the two cases either to be consolidated for argument in this Court or to be heard in tandem.[17]

In light of the consistent rejection of *Flook* by the court below, review by this Court is of prime importance to efficient administration of the patent system. The Patent and Trademark Office presently has pending more than 3000 patent applications in which the patentability of computer software or firmware is a potential issue. Some 1200 applications involve mathematical algorithms; over 1800 involve non-mathematical algorithms. Unless this Court grants review now, the CCPA's approach, exemplified by the decision below, puts the Commissioner in an untenable position. Should he follow the analysis required by the CCPA, he would be untrue to *Flook*, would usurp the congressional function by expanding the scope of the patent laws (see *Deepsouth Packing Co.* v. *Laitram Corp.*, 406 U.S. 518, 531 (1972)) and withal would settle nothing in the law, for the issues of patentability would remain to be litigated in infringement suits (see 35 U.S.C. 281 *et seq.*; 28 U.S.C. 1338). On the other hand, should he continue to adhere to his view that computer programs are themselves un-

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[17] We will send respondents a copy of our petition in *Diehr* as soon as it is filed.

patentable, there is the gloomy prospect of years of repeated, costly and unsuccessful litigation in the Court of Customs and Patent Appeals. This Court in *Flook* strongly intimated that computer programs are not patentable under current law. See 437 U.S. at 595. A definitive ruling to that effect would correctly leave to Congress the decision whether and how to extend the patent laws to computer programs, would greatly facilitate administration of the patent system, and would forestall the unsettling effects of a proliferation in the economy of unauthorized (and ultimately invalid) patents on computer programming.

CONCLUSION

For the foregoing reasons, the petition for a writ of certiorari should be granted.

Respectfully submitted.

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DECEMBER 1979

APPENDIX A

UNITED STATES COURT OF
CUSTOMS AND PATENT APPEALS

Appeal No. 79-533.

IN THE MATTER OF THE APPLICATION
OF
JOHN J. BRADLEY and BENJAMIN S. FRANKLIN

Serial No. 570,331.

Decided: July 5, 1979

Before MARKEY, Chief Judge, RICH, BALDWIN, and MILLER, Associate Judges, and COWEN,* Senior Judge.

RICH, Judge.

This appeal is from the decision of the Patent and Trademark Office (PTO) Board of Appeals (board) affirming the rejection of claims 1-6, all of the claims in appellants' application serial No. 570,331, filed April 21, 1975, for "Switch System Base Mechanism," as being drawn to subject matter which is non-statutory under 35 USC 101. We reverse.

The Invention

Appellants' invention is in the field of computer technology. It does not relate to computer applica-

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* The Honorable Wilson Cowen, U.S. Court of Claims, sitting by designation.

tions, i.e., any specific task that a computer is asked to perform, but rather to the internal operation of the computer and its ability to manage efficiently its operation in a multiprogrammed format. A multiprogrammed format is one in which the computer is capable of executing more than one program, and thus perform more than one application at the same time, without the need to reprogram the computer for each task it must perform.

Specifically, the invention relates to altering or repositioning information in the computer's system base. The system base of a computer is a fixed area in main memory which acts as the root for all information structures in the computer. In high performance computer systems, it is very advantageous to store portions of the system base in "scratchpad" registers [1] located in the central processing unit (CPU) of the computer rather than in main memory. This greatly enhances the speed of operation of the computer because the access time (the time it takes to retrieve information from a given place) associated with the scratchpad registers is less than that associated with main memory. A problem arises, however, because a programmer may wish to change the positions or content of information in the system base which happens to be located in the scratchpad

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[1] A scratchpad register, also known as a scratchpad memory, is a plurality of multibit storage locations, usually located in the central processing unit (CPU) of a computer, used for temporary storage of program information, operands, and calculation results for use by the computer's arithmetic and logic unit, and other information of a temporary nature.

registers. These registers are "invisible" to the programmer since, unlike main memory, they cannot be accessed by software (computer programs). Prior art systems altered the system base information resident in the scratchpad registers by either reinitializing the system base (completely reloading the system base containing the new information), a process which consumes a considerable amount of time, or by using software which takes advantage of the model-dependent properties of the particular computer. The latter method has the undesirable effect of resorting to reliance on model-dependent software, which is unacceptable to some computer users.

Appellants' invention enables system base information to be altered without having to resort to these techniques and their accompanying drawbacks. They accomplish their result by employing a "firmware" module, consisting of hardware elements permanently programmed with a microcode, which directs the data transfers, between the scratchpad registers and the system base located in main memory, which are necessary to effect the alteration.

Claim 1 is representative of the appealed claims:

> 1. In a multiprogramming computer system having a main memory, a central processing unit (CPU) coupled to said main memory, said (CPU) controlling the state of a plurality of groups of processes being in a running, ready, wait or suspended state, said computer system also having scratchpad registers being accessible to an operating system for controlling said multiprogramming computer system, a data structure

for storing coded signals for communicating between said processes and said operating system, and said scratchpad registers, said data structure comprising:

(a) first means in said data structure and communicating with said operating system for storing coded signals indicative of an address for a selected one of said processes;

(b) second means in said first means for storing coded signals indicating priority of said selected one of said processes in relation to others of said processes for obtaining control of said CPU when ready;

(c) third means in said data structure and communicating with said operating system, for storing coded signals indicative of an address for a selected one of said plurality of groups of processes, and,

(d) fourth means coupled to said data structure and said scratchpad registers, for generating signals causing the changing of information in said data structure and said scratchpad registers.

The Rejection

The examiner rejected the appealed claims on the authority of *Gottschalk* v. *Benson*, 409 U.S. 63, 175 USPQ 673 (1972) (hereinafter *Benson*) before the Supreme Court's decision in *Parker* v. *Flook*, 437 U.S. 584, 198 USPQ 193 (1978) (hereinafter *Flook*). In his final rejection, dated October 27, 1976, the examiner stated that the subject matter "deemed as

the invention" is "a data structure" and then made the following analysis:

> The term "data structure" as recited in the claim is comprised of four entities described as "first means", "second means", "third means", and "fourth means." Whether these so called "means" are hardware structure which store coded signals for performing a particular function or whether they refer to coded signals representing computer control words per se, any life which the claim may have in view of that which is admittedly old in the art, resides in the "technique" (page 5, line 4) or "switch-system base instruction" (page 5, lines 13 and 14) for solving the problem of changing information of the system base which is located in scratchpad registers which software cannot access (page 4, line 20). The invention then is embodied in the coded signals representing instructions to the computer, the running process word RPW (first means of claim), priority level indicator word PRI (second means), J Table word and G Table word (third means), and micro-instruction of Figures 15c [sic, 15b] and 15c as found in the central store 1301. The invention resides in a "data structure" or an algorithm designed to control the multiprogramming computer to solve the particular problem indicated.
>
> Under the ruling in *Gottschalk* v. *Benson*, 175 USPQ 673, the instant claims, depending upon a program implemented algorithm for patentability, are deemed nonstatutory subject matter.

Appellants requested reconsideration and argued that their claims are directed to data structures in

hardware which are "specific new, novel and unobvious [in] arrangement." They asserted that by stating that the invention resided in a "technique," the examiner was clearly disregarding the claims and interpreting the invention strictly on the basis of what is found in the specification, because no "technique" is *claimed.* They stated that even if a technique (i.e., process) were claimed, *Benson* does not render all such inventions nonstatutory, and that their invention does not involve a *mathematical* algorithm.[2]

In his Answer before the board, the examiner noted that all of the limitations found in claim 1 were old in the art and that the "claim is thus reciting prior art coupled with subject matter which the U.S. Supreme Court has found to be non-statutory in *Benson.*" Appellants responded in their reply brief that it makes no difference whether individual elements are old in the art and that it is the elements in combination which define the invention as a whole.

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[2] In *Benson,* the Supreme Court was clearly limiting its discussion to mathematical algorithms:

> The patent sought is on a method of programming a general purpose digital computer to convert signals from binary coded decimal form into pure binary form. *A procedure for solving a given type of mathematical problem is known as an "algorithm." The procedures set forth in the present claims are of that kind; that is to say, they are a generalized formulation for programs to solve mathematical problems of converting one form of numerical representation to another.* [409 U.S. at 65, 175 USPQ at 674 (emphasis ours).]

It is not clear whether the examiner regarded appellants' invention as a mathematical algorithm, but, as will become evident, the board did so regard the invention.

The Board

The board rendered its decision on September 20, 1978, after the Supreme Court's decision in *Flook*. After incorrectly stating that none of the claims recited the term "firmware," [3] the board analyzed appellants' claims element by element, concluding that the only novel arrangement of the recited structures resided in the microprogramming, "which together with its attendant memory hardware appears to constitute firmware."

Apparently on the basis of *Flook*, the board affirmed the rejection because it was of the opinion that the appealed claims are directed to a method of calculation or mathematical algorithm. The board found the claims similar to the claims at issue in *In re Waldbaum*, 559 F.2d 611, 194 USPQ 465 (CCPA 1977), which included language characterized by the board as "obviously related to calculating and mathematical problem solving." [4] Although the claims

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[3] Claim 3, as well as dependent claims 4-6, explicitly recites firmware. Firmware is a term of art in the computer field and refers to microinstructions permanently embodied in hardware elements. For a further discussion, *see generally* Ross, *The Patentability of Computer "Firmware,"* 59 JPOS 731 (1977). We need not and do not decide at this time whether firmware *per se* is statutory under 35 USC 101 because the invention *as a whole* is not directed thereto. See our further discussion, infra.

[4] Waldbaum claim 1 reads in pertinent part:

> a method * * * to *count the number* of busy lines * * * *comparing means* * * * *to derive the number of l's* in said data word * * *. [Emphasis ours.]

[Footnote continued on page 8a]

here at issue do not contain similar mathematical language, the board said that this "does not make the functions attendant the 'means' of appellants' claims any less mathematical or less related to an algorithm within the meaning assigned that term by the USSC in *Benson*."

To support its conclusion that the appealed claims are mathematical in nature, the board relied on a statement in the specification to the effect that all of the data in the computer are in binary form, but may be interpreted as binary coded decimal, decimal or alphanumeric. We reproduce the board's reasoning in full:

> Since digital computers normally operate in some numerical radix, binary, binary coded decimal, or the like, we consider the operation of appellants' claimed invention to be mathematical.
>
> Every operation performed in appellants' invention as claimed involves the accommodation of data and instructions to the size of the registers in memory, and to the positional assignment to the registers in memory by the use of some numerical measure or quantity effected by way of electrical signals. In whatever form the instructions employed in appellants' invention are characterized, numerical or otherwise, we think it is accurate to say that the operation of appellants'

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[4] [Continued]

It is clear that this claim recites a mathematical algorithm. It solves a mathematical problem, to wit, *counting* a number of busy lines in a telephone system.

> structure is mathematical and that the instructions constitute a procedure which is algorithmic in character, to the same degree as that of the Waldbaum structure and that satisfactory operation of the apparatus claimed represents the successful solution of a mathematical problem falling within the definition of algorithm supplied in *Benson* and reiterated in *Flook*.
>
> Here the method of calculation is to be used in the internal operation of the computer system and the claims recite such an end use by means of the functions recited for the various means. A claim for an improved method of calculation, even when tied to a specific end use, is unpatentable subject matter under 35 USC 101, *Flook, supra.*

In summary, the board stated that the claims are drawn to apparatus in form only, and couple the apparatus (which it asserts is old in the art) "with subject matter, namely, programming, which is nonstatutory under the *Benson*, *Christensen*,[5] *Waldbaum* and *Flook* cases * * *."

OPINION

The examiner's basis for the rejection is grounded on the erroneous interpretation of the Supreme Court's decision and opinion in *Benson*, namely, that all computer program or program related inventions are nonstatutory under § 101. Both the Supreme

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[5] *In re Christensen*, 478 F.2d 1392, 178 USPQ 35 (CCPA 1973).

Court [6] and this court [7] have thoroughly repudiated this view. Our decision, therefore, is based solely on the analysis made by the board.

The board said that the claims do not *directly* recite a mathematical formula, algorithm, or method of calculation, but, nevertheless, held the claims to be mathematical in nature. As appears from the quoted portion of the board opinion, the board regarded the fact that digital computers operate in some number radix as conclusive on the issue of whether the appealed claims recite a mathematical algorithm in the *Benson* and *Flook* sense. The board did not, however, direct attention to any specific formula it thought is utilized, or to what, if anything, the mathematical calculations alleged to be present in the claims are directed.

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[6] In *Benson*, the Court stated, 409 U.S. at 71, 175 USPQ at 676 (emphasis ours):

> It is said that this decision precludes a patent for any program servicing a computer. *We do not so hold.*

In *Flook*, the Court stated, 437 U.S. at 595 n.18, 198 USPQ at 199 n.18:

> Very simply, our holding today is that a claim for an improved method of calculation, even when tied to a specific end use, is unpatentable subject matter under § 101.

[7] *See In re Gelnovatch*, 595 F.2d 32, 36-37, 201 USPQ 136, 141 (CCPA 1979); *In re Johnson*, 589 F.2d 1070, 1075, 200 USPQ 199, 205 (CCPA 1978); *In re Sarkar*, 588 F.2d 1330, 1333, 200 USPQ 132, 137 (CCPA 1978); *In re Freeman*, 573 F.2d 1237, 1244, 197 USPQ 464, 470 (CCPA 1978); *In re de Castelet*, 562 F.2d 1236, 1240, 195 USPQ 439, 443 (CCPA 1977); *In re Chatfield*, 545 F.2d 152, 155-56, 191 USPQ 730, 733-34 (CCPA 1976), *cert. denied*, 434 U.S. 875, 195 USPQ 465 (1977).

We do not agree with the board. We are constrained to reject its reasoning. Such reasoning leads to the conclusion that any computer-related invention must be regarded as mathematical in nature, a conclusion which is not compelled by either *Benson* or *Flook*.

The board's analysis confuses *what* the computer does with *how* it is done. It is of course true that a modern digital computer manipulates data, usually in binary form, by performing mathematical operations, such as addition, subtraction, multiplication, division, or bit shifting, on the data. But this is only *how* the computer does what it does. Of importance is the significance of the data and their manipulation in the real world, i.e., *what* the computer is doing. It may represent the solution of the Pythagorean theorem, or a complex vector equation describing the behavior of a rocket in flight, in which case the computer is performing a mathematical algorithm and solving an equation. This is what was involved in *Benson* and *Flook*. On the other hand, it may be that the data and the manipulations performed thereon by the computer, when viewed on the human level, represent the contents of a page of the Milwaukee telephone directory, or the text of a court opinion retrieved by a computerized law service. Such information is utterly devoid of mathematical significance. Thus, the board's analysis does nothing but provide a quick and automatic negative answer to the § 101 question simply because a computer program is involved.

Appellants have continuously insisted that they are claiming a new and unobvious combination of *hardware elements*, i.e., a new machine or apparatus.[8] The issues of novelty and unobviousness[9] are not before us, but we agree with appellants insofar as they characterize their invention as a machine or apparatus. The board likewise seems to agree on this point. In its opinion, it identifies all of the "means" of appellants' claim 1 as structural hardware elements, such as registers, portions of main memory and control store,[10] and other computer components. Thus, the claim falls literally within the boundaries of § 101.

Appellants have characterized their combination of hardware elements as a mechanism which enables the computer to alter information in its system base in a manner not previously possible. They are in no way claiming the altered information; in fact, the particular information acted upon by appellants' invention is irrelevant to the operation of the invention itself.

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[8] 35 USC 101 states:

> Whoever invents or discovers any new and useful process, *machine*, manufacture, or composition of matter, *or any new and useful improvement thereof*, may obtain a patent therefor subject to the conditions and requirements of this title. [Emphasis ours.]

[9] 35 USC 102, 103.

[10] The control store of a computer is a plurality of multibit storage locations (memory) containing microinstructions, which, when decoded by appropriate circuitry, provide control signals which cause specific operations to take place in the computer's CPU.

We see no difference in this regard, with respect to being within § 101, between appellants' claimed invention and a strictly mechanical adding machine, which is certainly statutory if claimed in a manner which does not embrace any particular calculation that the machine is capable of making.

The PTO regards as significant the fact that firmware is involved in the present invention. In a sense, firmware may be likened to software (computer programs); it is information which has been embodied into hardware by, for example, destroying fusible links in a read only memory (ROM) array. In appellants' invention, the information contained within the firmware, which is located in the control store of the computer, directs the desired information transfers within the system base.

If appellants were claiming the information embodied in the firmware or the firmware itself, per se, a different case would be presented. We express no opinion on the statutory nature of such an invention, a question not before us. Appellants are claiming a combination of hardware elements, one of which happens to be a portion of the computer's control store microprogrammed in a particular manner. It is this subject matter with which we must deal.

From our reading of appellants' specification, their claimed "data structure" is merely that which results from the arrangement of the recited hardware elements in the claimed manner. It is the result of certain structural "means" performing certain recited functions as explicitly sanctioned by 35 USC

112, sixth paragraph. We disapprove the board's distillation of appellants' claim down to the information contained in the firmware in order to hold it nonstatutory. The invention is not claimed in that manner, and, in this case, we see no reason to view the claim format as a subterfuge for masking the presence of an essentially nonstatutory invention.

Even though the claimed invention is a machine, we must nevertheless determine whether the claim recites a mathematical algorithm, and, if so, whether it preempts the use of the algorithm. *In re Noll*, 545 F.2d 141, 148, 191 USPQ 721, 726 (CCPA 1976). In doing so, we apply the two-step test in *In re Freeman*, supra note 7.

When we examine appellants' invention as a whole under the first step of this test, including the information microprogrammed into the firmware element as depicted in Figs. 14(a-i) and 15(b-c), we fail to detect the presence of any *mathematical* algorithm. In altering information in the system base as desired, certain "calculations" are made, such as determining whether a given quantity is equal to zero, or, as noted by the solicitor, multiplying an address in memory by sixteen to arrive at another address. However, it certainly cannot be said that comparing with zero or multiplying by sixteen is preempted by appellants' claims. Furthermore, the presence of these calculations does not transform the invention as a whole into a method of calculation. *Cf. In re Gelnovatch*, supra note 7. There is no solution of an equation, such as the new alarm limit in *Flook*, or the equiva-

lent pure binary number, as in *Benson*, present in the computer after the task has been completed. *See In re Chatfield*, supra note 7.

In summary, we have examined the claims thoroughly and we do not find any mathematical formula or mathematical method of calculation, improved or otherwise, which is either claimed as such or essential to the vitality of the claims. We find that the invention is a combination of tangible hardware elements —a machine—including some hardware elements which contain microprogrammed information termed "firmware." We do not find the invention to be nonstatutory under the authority of *Benson* or *Flook*, or under the authority of our own cases, such as those cited at note 7 ante. Therefore, the decision of the board is *reversed.*

REVERSED

APPENDIX B

UNITED STATES COURT OF CUSTOMS AND PATENT APPEALS

MANDATE

No. 79-533

IN THE MATTER OF THE APPLICATION

OF

JOHN J. BRADLEY and BENJAMIN S. FRANKLIN

Serial No. 570,331

ON APPEAL from the Board of Appeals

This CAUSE having been heard and considered, it is

ORDERED and ADJUDGED: Reversed

Dated July 5, 1979

A True Copy
GEORGE E. HUTCHINSON,
Test:
Clerk, United States Court of
Customs and Patent Appeals

Certified this 27th day of July 1979

/s/ George E. Hutchinson
GEORGE E. HUTCHINSON

APPENDIX C

OPINION AND DECISION OF BOARD OF APPEALS, SEPTEMBER 20, 1978.

Before Burns and Spencer, Examiners-in-Chief, and Craig,

Acting Examiner-in-Chief.

Burns, Examiner-in-Chief

This is an appeal from the final rejection of claims 1-6, constituting all of the claims presently in the case.

The subject matter concerns computer "firmware." [1] In their brief appellants characterize their invention in the following words:

> ". . . More specifically, the invention concerns a combination of hardware including a model-independent instruction means which is implemented in firmware, for adding capability and increased functionality to the computer system. As defined by the Applicants' claims, the present invention is directed to a combination of hardware structures controlled by a microprogrammed control system which provides for the generation of signals which cause the creation of

---

[1] The term has been defined as follows:

firmware-Logic circuits in read-only memory that may be altered by the software under certain circumstances, (*Computer Dictionary and Handbook,* Sippl and Sippl, published by Howard W. Sams & Co., Inc., The Bobbs-Merrill Co. Inc., 2nd Ed., 1972.)

an image of a communication center at another location, and for the generation of signals which causes the interchange of the information between the commuication center and its image."

More particularly, the problem addressed and appellants' solution thereto may be discerned from the following selected portions of appellants' disclosure. From page 4, beginning at line 15:

"High performance computing systems find it necessary to store portions of the system base in internal scratchpad registers instead of main memory, and hence inaccessible and invisible to software running in the system. Accordingly, a problem results when software (i.e. the programmer) wants to change positions or change information of the system base which happens to be located in these internal central processor scrathpad [*sic*] registers which software cannot access."

From the same page, beginning at line 24:

"The problem has been solved in one of two ways. The first method is to simply re-initialize the entire system, loading the system base with different contents as a result of a new initialization process. This technique is extremely time-consuming and quite undesirable.

"A second technique for solving the problem is to have the software employ special model-independent properties of the particular machine on which it was running, to change the system base. This results in the very undesirable property of completely model-dependent software—

a feature which certainly does not serve to endear a computer manufacturer to a customer.

"What is needed therefore is a technique of changing information in the system base both in main memory and internal scratchpad registers making the system base in scratchpad memory accessible to software but not visible to software i.e. cannot be read by the software."

From page 5, beginning at line 26:

"A model-independent instruction in firmware is provided to change, upon its execution, information in the system base which is located in both main memory and internal scratchpad registers.

"The system base located at a location specified by the boundary address register BAR in main memory, is copied into a new location in main memory with predetermined portions of its information changed. This is readily accomplished by the operating system. . .

* * * * *

The switch system base instruction then transfers the information which is in the system base at the new location into the system base at the location specified by BAR and also that portion of the system base located in scratchpad memory."

We reproduce claim 1 as representative, however, in so doing, we interleave indented explanation (identified parenthetically with capital letters A to D) of the respective portions of the claimed subject matter, the explanation being derived from pages 9 and 10 of appellants' brief

1. In a multiprogramming computer system having a main memory, a central processing unit (CPU) coupled to said main memory, said (CPU) controlling the state of a plurality of groups of processes being in a running, ready, wait or suspended state, said computer system also having scratchpad registers being accessible to an operating system for controlling said multiprogramming computer system, a data structure for storing coded signals for communicating between said processes and said operating system, and said scratchpad registers, said data structure comprising:

(a) first means in said data structure and communicating with said operating system for storing signals indicative of an address for a selected one of said processes;

> (A) ". . . data structure claimed is comprised of the first means which is the structure of the running process word register at BAR + 56 of the system base structure of Figure 6. The system base structure is described with the particularity of 35 USC 112 beginning on page 35 through 41. Its use is further described beginning on page 41. The running process word register structure is further shown with particularity on Figure 11j and is described with particularity beginning on page 39 of the specification. . ."

(b) second means in said first means for storing coded signals indicating priority of said selected one

of said processes in relation to others of said processes for obtaining control of said CPU when ready;

> (B) ". . . The second means which is an element within the first is part of the running process word register and is identified with reference to numeral 1129. . ."

(c) third means in said data structure and communicating with said operating system, for storing coded signals indicative of an address for a selected one of said plurality of groups of processes; and,

> (C) ". . . The third means within the data structure is the J table word means and the G table word means at BAR and BAR + 4 on Figures 11a and 11b and described in the specification. . ."

(d) fourth means coupled to said data structure and said scratchpad registers, for generating signals causing the changing of information in said data structure and said scratchpad registers.

> (D) ". . . Finally, the fourth means claimed is shown on Figures 13a and 13b is a central store as microprogrammed by the microprogram as disclosed by the flow charts of Figures 15b and 15c. Details of the control store which is microprogrammed are shown on Figure 13b (it should be understood that control stores are old in the art and persons of ordinary skill in the art

can microprogram them when provided with the flow charts of the microprogram and this results in the firmware. . ."

THE REJECTION

All of the claims have been rejected under 35 USC 101 as drawn to non-statutory subject matter. The examiner cites *Gottschalk* v. *Benson*, 409 US 63, 175 USPQ 673 (1972).

In his answer, beginning at page 5, line 6, the examiner explains his position in part as follows:

> ". . . Claim 1 has been couched in apparatus format and recites first means through fourth means. The first means through third means set forth means for storing signals and read upon registers or memory locations within the operating system, already shown to be old in the art. The function of or attribute of the signals stored in the first, second, and third means for storing may be classified as indicating an address for a selected one of a plurality of processes, indicating a priority of said selected process relative to other processes, and indicating an address of a selected one of the plurality of processes, respectively. There is clearly no novelty to be found here for distinguishing over that which is deemed to be old in the art.
>
> "The fourth means is stated as means for generating signals causing the changing of information in the data structure and scratchpad registers and is categorized by applicants' brief, page 10, as a control store as microprogrammed by the microprogram of Figures 15b and 15c.

> The use of control stores in computer systems has been shown to be old in the art in the listing of publications and U.S. Patents in paragraph 19 of Appendix I, amendment filed August 11, 1976. In fact, paragraph 22 of the Appendix I correctly indicates that microprogrammed computer processors including microprogrammed control units are old in the art and suggests that the systems shown in the two cited patents are capable of practicing or implementing the instant invention. . .
>
> * * * * *
>
> Applicants' invention resides in an instruction in firmware which changes, upon execution, information in the system base. The claim is thus reciting prior art coupled with subject matter which the U.S. Supreme Court has found to be non-statutory in *Benson*. . ."

The appellants' argument is to the effect that only hardware, that is, structure, has been recited wherefore the *Benson* decision is inapposite. They characterize the examiner's rationale as procrustean "in forcing an arbitrary conclusion or solution to the facts," brief, bottom of page 8.

OPINION

In order to determine what appellants regard as their invention, it is necesary to consider the claimed subject matter as a whole, *In re* Noll, 545 F.2d 141, 191 USPQ 721 (CCPA, 1976), *In re* Chatfield, 545 F.2d 152, 191 USPQ 721 (CCPA, 1976). With this caveat in mind it is nevertheless appropriate to con-

sider the features, both novel and otherwise, within the claims, as did the Court in *Parker* v. *Flook*, 437 US—, 198 USPQ 193 (1978), an approach "not at all inconsistent with the view that a patent claim must be considered as a whole."

Analysis of Claimed Subject Matter

First, we observe that neither the term "firmware" nor an apparent equivalent appears in any of the claims, cf. USC 112, last sentence. The various recited "means" for storing, communicating and generating are not to be construed as limited to firmware.

In an amendment filed August 11, 1976 (Paper No. 4), appellants amended their specification with APPENDIX I providing numbered items which refer to prior art features, to which APPENDIX we will have occasion to refer.

Our comments on the elements recited in the claims will follow their order of recitation within each claim.

Claim 1

For the main memory, appellants in APPENDIX I, (11)(a) appear to rely for disclosure upon references 2-7 found on page 2 of the specification. References 2-6 upon inspection appear to show a mix of block diagrams directed to both hardware and software. Reference 7 shows only flow charts without a suggestion of hardware or apparatus structure. To the extent that references 2-6 disclose structure or hardware it would appear that, as such, these references demonstrate that memory *per se* is old. It does

not appear that appellants have argued otherwise, rather, appellants urge that they claim ". . . new, novel and unobvious *arrangement* of these structures . . .," brief, page 9, beginning at line 4, (our emphasis).

As for the central processing unit (CPU), no specific reference has been identified in APPENDIX I by this term, nevertheless, item (22) thereof describes microprogrammed computer processors employing microprogrammed control units "with which the instant invention may be practiced."

Concerning the "data structure" of the claim, page 11, beginning at line 18, of the specification characterizes this feature as being composed of data formats, software visible registers, and instruction formats. The first and last of these three features are described in paragraphs A of specification page 11, line 21 and J of page 14, line 15. Nothing in this description of formats suggests hardware. It would seem that reliance must be placed on the software visible registers, the second feature, as described in paragraph E, page 12, beginning at line 24 of the specification. Appellants appear to rely as prior art for such features upon patents described in (12) and (13) of APPENDIX I.

Appellants have characterized the "first means" as the running process word register within the data structure. Save for the actual word stored which, it would appear, will change depending upon the nature of the data processing undertaken, this feature con-

sists of space in memory (BAR + 56 as shown in Figure 6) as part of the system base.

From the foregoing it would seem that the data structure consists of at least one software visible register, and the first means in said data structure constitutes that register (or a portion of it) with a particular word stored therein, an address. It does not appear that the "first means" constitutes novel hardware distinct from the registers designated above representing the data structure for which appellants have referenced prior art.

Similarly, for the second and third means of the claim, so much thereof as may be characterized as hardware would seem to have antecedents in the prior art registers as part of memory described above for the data structure.

The fourth means of the claim has been designated by the appellants as a central store, known to be old, brief, page 10, line 8. It is there characterized:

> ". . . as microprogrammed by the microprogram as disclosed by the flow charts of figures 15b and 15c. . ."

Appellants have buttressed this by the prior art references in APPENDIX I (19), (20) and (21).

From the above we conclude that the components recited in claim 1 appear to be old in the art constituted as registers as part of memory (the latter being hardware) save for the microprogramming provided by element (d) of the claim, the fourth means. Any "specific new, novel and unobvious arrangement of these structures," brief, page 9, beginning at line 4,

would appear to be provided by the microgramming of Figures 15b and 15c, which together with its attendant memory hardware appears to constitute firmware.

Claims 2-6

As to these claims, analysis of the nature set forth above in connection with claim 1 leads to a similar conclusion. We would only add that, with respect to claim 4, appellants have made reference to arithmetic and logic units in APPENDIX I(2)(a). The element characterized as "hardware gate" found in claim 5 appears also to be part of memory, for which appellants have provided prior art references, under the control of the programming shown in Figures 15b and 15c, see specification page 64, beginning at line 26 et seq., of the specification.

Authorities

Appellants in their brief rely upon *In re* Noll, *supra*, and *In re* Chatfield, 545 F.2d 152, 191 USPQ 730 (CCPA, 1976). In their reply brief, appellants comment upon *In re* Waldbaum, 559 F.2d 611, 194 USPQ 465 (CCPA, 1977) and urge the significance of the court's language in distinguishing the Waldbaum subject matter from that in *In re* Christensen, 478 F.2d 1392, 178 USPQ 35 (1973). Appellants there maintain that "the instant invention does not involve nor does it claim a method, process or algorithm directed to a calculation." We disagree. It appears to us that Waldbaum, if anything, supports the examiner's position, in that the Court proscribed

claims "which are directed to methods for controlling the operation of a data processor," basing its decision upon the *Benson* decision. It would seem that appellants' claims are similarly directed.

We recognize that method claims were under consideration in Waldbaum whereas here the claims are in apparatus format. In *In re* Freeman, 197 USPQ 464 (CCPA, 1978) the Court found such a circumstance to be of no moment:

> "Though a claim expressed in 'means for' (functional) terms is said to be an apparatus claim, the subject matter as a whole of that claim may be indistinguishable from that of a method claim drawn to the steps performed by the 'means.'
>
> "We agree with the solicitor's contention that if allowance of a method claim is proscribed by Benson, it would be anomalous to grant a claim to apparatus encompassing any and every 'means for' practicing that very method."

We are aware that the Waldbaum claims included characteristic language obviously related to calculating and mathematical problem solving, thus (from *Waldbaum* claim 1):

> ". . . a method . . . to *count* the number of busy lines. . . . . *comparing* means . . . to derive the *number of 1's* in said data word." (Emphasis added.)

That appellants' claim are absent similar characteristic language does not make the functions attendant the "means" of appellants' claims any less mathe-

matical or less related to an algorithm within the meaning assigned that term by the USSC in *Benson*.

The specification states, page 12, line 2:

> "All data are in binary form, but may be interpreted as binary, decimal or alphanumeric."

Since digital computers normally operate in some numerical radix, binary, binary coded decimal, or the like, we consider the operation of appellants' claimed invention to be mathematical.

Every operation performed in appellants' invention as claimed involves the accommodation of data and instructions to the size of the registers in memory, and to the positional assignment to the registers in memory by the use of some numerical measure or quantity effected by way of electrical signals. In whatever form the instructions employed in appellants' invention are characterized, numerical or otherwise, we think it is accurate to say that the operation of appellants' structure is mathematical and that the instructions constitute a procedure which is algorithmic in character, to the same degree as that of the Waldbaum structure and that satisfactory operation of the apparatus claimed represents the successful solution of a mathematical problem falling within the definition of algorithm supplied in *Benson* and reiterated in *Flook*.

Here the method of calculation is to be used in the internal operation of the computer system and the claims recites such an end use by means of the functions recited for the various means. A claim for an

improved method of calculation, even when tied to a specific end use, is unpatentable subject matter under 35 USC 101, *Flook, supra.*

SUMMARY

We agree with the examiner. The claims under consideration, when each is considered as a whole, recite apparatus as a matter of form only, and couple such apparatus, which appellants have indicated as old in the art, with subject matter, namely, programming, which is nonstatutory under the *Benson, Christensen, Waldbaum* and *Flook* cases, *supra.* Employing appellants' metaphor, the claims at bar, we think, extend beyond the procrustean statutory bed.

The decision of the examiner is affirmed.

AFFIRMED

/s/ Burns
Examiner-in-Chief

/s/ Spencer
Examiner-in-Chief

/s/ Craig
Examiner-in-Chief
(Acting)

BOARD OF APPEALS

APPENDIX D

LETTER OF EXAMINER, MARCH 12, 1976.

☒ This application has been examined

Responsive to communication filed ☐ This action is made final.

A SHORTENED STATUTORY PERIOD FOR RESPONSE TO THIS ACTION IS SET TO EXPIRE THREE (3) MONTH(S) FROM THE DATE OF THIS LETTER.

PART I

The following attachments(s) are part of this action:

a. ☒ Notice of References Cited, Form PTO-892. b. ☐ Notice of Informal Patent Drawing, PTO-948.

c. ☐ Notice of Informal Patent Application, Form PTO-152. d. ☐

PART II

Summary of Action

1. ☒ Claims 1 - 6 are presented for examination.

2. ☐ Claims _____ are allowed.

3. ☐ Claims _____ would be allowable if amended as indicated.

4. ☒ Claims 1 - 6 are rejected.

5. ☐ Claims _____ are objected to.

6. ☐ Claims _____ are subject to restriction or election requirement.

7. ☐ Claims _____ are withdrawn from consideration.

8. ☐ Since this application appears to be in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under Ex parte Quayle, 1935 C.D. 11; 453 OG. 213.

9. ☐ Since it appears that a discussion with applicant's representative may result in agreements whereby the application may be placed in condition for allowance, the examiner will telephone the representative within about 2 weeks from the date of this letter.

10. ☐ Receipt is acknowledged of papers under 35 USC 119, which papers have been placed of record in the file.

11. ☐ Applicant's claim for priority based on an application filed in _____ on _____ is acknowledged. It is noted, however, that a certified copy as required by 35 USC 119 has not been received.

12. ☐ Other

1) Due to the length of the specification it has not been checked to the extent of determining all minor errors. Applicants are requested to review the entire specification and correct any errors noted.

2) The Abstract of the Disclosure should be reviewed and corrected to more specifically and clearly state the character of the subject matter deemed to be new in the art.

3) In the specification, pages 2-4 and various others throughout the disclosure, application serial numbers and filing dates have been omitted.

In lines 1 and 2, page 2, the purpose of the procedure to allow incorporation by reference to previous patents and applications was to reduce the length of disclosure in related applications and simplify the examining and printing procedures involved. Applicants have incorporated by reference numerous applications and/or patents which do not appear to be "essential subject matter" relative to the disclosure of the instant invention. If these prior applications are to be referenced as related applications then it should be so indicated rather than incorporating all of them by reference.

4) The specification is objected to under 35 USC 112 as failing to set forth the subject matter of the invention in such terms as to enable one to make and use the invention without undue experimentation. The basic elements of the system are disclosed in no more detail than hollow rectangles and the complex interrelationship between the various elements is disclosed only in functional statements of desired re-

sults. For example, the control unit 130 of Figure 1 is stated to contain firmware which initializes the system, controls the CPU 104 and IOC 105, and encodes an instruction set. However, the elements of the control unit and the instructions for configuring the various elements have not been disclosed in sufficient detail to enable one of ordinary skill in the art to reconstruct the invention.

Applicants have referred to basic data structures on page 11 and following disclosure as being data formats, software visible registers, and instruction formats. This use of the term "structures" to refer to data formats, etc. is carried over into the claims and results in confusion as to the nature of the invention. The subject matter disclosed in Figure 2 must be deemed in the nature of data format and not of the nature of apparatus as usually intended by use of the word "structure." Clarification is requested.

5) Claims 1-6 are rejected as drawn to subject matter which is inadequately disclosed, 35 USC 112, first paragraph.

6) Claims 1-6 are further rejected under 35 USC 112, second paragraph, as failing to particularly point out and distinctly claim the subject matter sought to be patented.

The structural connections and cooperative relationship between the various elements comprising the claimed combination have not been clearly established. Although the claims are recited as a combination of devices in the means plus statement of func-

tion language, most of the claim language does not recite "structure" in the sense of apparatus but rather uses "means" to refer to software or firmware instructions. Applicant is therefore requested to point out the structure in the drawings upon which the various "means" are to be read.

7) Claims 1-6 are further rejected under 35 USC 101 as drawn to non-statutory subject matter.

The Supreme Court in *Gottschalk* v. *Benson*, 175 USPQ 673, stated that Court's views on the patentability of certain claims which set forth an invention related to the processing of data by a programmed computer.

The Court in Benson addressed itself to the broad question of patentability of computer programs and stated that if such subject matter is to be patented, considerable programs are raised which only committees of Congress can manage. Justice Douglas, speaking for the Court, declined to decide such policy matters and refused to extend the patent statutes to embrace computer programming, absent considered action by the Congress.

8) Claims 1-6 are further rejected under 35 USC 102 as unpatentable over the Hauck patent. The apparatus in Figure 1 of Hauck cooperates to perform the function of applicant's claimed invention.

9) The additional art cited, although not applied against the claims, is considered pertinent in showing related systems.

10) All claims have been rejected. This application should be put in condition for final disposition.

/s/ Charles E. Atkinson
CHARLES E. ATKINSON
EXAMINER
GROUP ART UNIT 236

LETTER OF EXAMINER, OCTOBER 27, 1976.

[x] Responsive to communication filed on August 11, 1976.

[x] This action is made final.

A SHORTENED STATUTORY PERIOD FOR RESPONSE TO THIS ACTION IS SET TO EXPIRE THREE (3) MONTH(S) ~~DAYS~~ FROM THE DATE OF THIS LETTER.

FAILURE TO RESPOND WITHIN THE PERIOD FOR RESPONSE WILL CAUSE THE APPLICATION TO BECOME ABANDONED. 35 U.S.C. 133

PART I THE FOLLOWING ATTACHMENT(S) ARE PART OF THIS ACTION:

1. [ ] Notice of References Cited, Form PTO-892.
2. [ ] Notice of Informal Patent Drawing, PTO-948.
3. [ ] Notice of Informal Patent Application, Form PTO-152
4. [ ]

PART II SUMMARY OF ACTION

1. [x] Claims 1 - 6 are pending in the application.

   Of the above, claims _____ are withdrawn from consideration.

2. [ ] Claims _____ have been cancelled.

3. [ ] Claims _____ are allowed.

4. [x] Claims 1 - 6 are rejected.

5. [ ] Claims _____ are objected to.

6. [ ] Claims _____ are subject to restriction or election requirement.

7. [ ] The formal drawings filed on _____ are acceptable.

8. [ ] The drawing correction request filed on _____ has been [ ] approved. [ ] disapproved.

9. [ ] Acknowledgement is made of the claim for priority under 35 U.S.C. 119. The certified copy has
   [ ] been received. [ ] not been received. [ ] been filed in parent application; serial no. _____ filed on _____

10. [ ] Since this application appears to be in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under Ex parte Quayle, 1935 C.D. 11; 453 OG. 213.

11. [ ] Other

1) This is in response to the amendment filed August 11, 1976. Claims 1 through 6 remain in the application.

2) Claims 1 through 6 are again rejected as being directed to non-statutory subject matter under 35 USC 100 and 101.

Applicants contend that "the present invention is directed to hardware structures controlled by a microprogrammed control system which provides for the generation of signals which cause the creation of an image of a communication center at another location and for the generation of signals which causes the interchange of the information between the communication center and its image." Applicants further contend that "the structure and microprogram control system defined by applicants' claims are clearly within the technological arts" and is thus statutory subject matter within the intended bounds of 35 USC 100 and 35 USC 101.

Although applicants have now amended the claims to couch the claimed subject matter in language inferring structural entities and interconnections, the disclosed invention and specification language clearly indicate that the invention resides in a "technique" or "switch base instruction" for changing information in the system base in both the main memory and internal scratchpad registers making the system base in scratchpad memory accessible to software but not visible to software i.e. cannot be read by the software.

In claim 1, the preamble sets forth the environment as a multiprogramming computer system comprised of such well known components as a main memory, central processing unit, and scratchpad registers. The subject matter deemed as the invention is then stated as "a data structure." The nature of this subject matter is disclosed beginning on page 35 of the specification and in Figure 6. Beginning in line 12 of page 35, it is stated that "the format of the system base 600 is shown." It is further stated that the "system base resides in absolute main memory and is developed by firmware." The term "data structure" as recited in the claim is comprised of four entities described as "first means", "second means", "third means", and "fourth means." Whether these so called "means" are hardware structure which store coded signals for performing a particular function or whether they refer to coded signals representing computer control words per se, any life which the claim may have in view of that which is admittedly old in the art, resides in the "technique" (page 5, line 4) or "switch-system base instruction" (page 5, lines 13 and 14) for solving the problem of changing information of the system base which is located in scratchpad registers which software cannot access (page 4, line 20). The invention then is embodied in the coded signals representing instructions to the computer, the running process word RPW (first means of claim), priority level indicator word PRI (second means), J Table word and G Table word (third means), and micro-instructions of Fig-

ures 15c and 15c as found in the central store 1301. The invention resides in a "data structure" or an algorithm designed to control the multiprogramming computer to solve the particular problem indicated.

Under the ruling in *Gottschalk* v. *Benson*, 175 USPQ 673, the instant claims, depending upon a program implemented algorithm for patentability, are deemed nonstatutory subject matter.

3) All claims have been rejected. This action is hereby made a *FINAL REJECTION*.

CHARLES E. ATKINSON
EXAMINER
GROUP ART UNIT 236

LETTER OF EXAMINER, FEBRUARY 1, 1977.

ADVISORY ACTION

☒ THE PERIOD FOR RESPONSE IS EXTENDED TO RUN 4 MONTHS FROM THE DATE OF THE FINAL REJECTION. 855 O. G. 1109.

☐ Appellant's Brief is due in accordance with Rule 192 (a).

Applicant's response to the final rejection, filed Dec. 30, 1976, has been considered with the following effect, but it is not deemed to place the application in condition for allowance:

1. ☐ The proposed amendments to the claims and/or specification will not be entered and the final rejection stands because:

   a. ☐ There is no convincing showing under Rule 116 (b).
   b. ☐ They raise new issues that would require further consideration and/or search.
   c. ☐ They raise the issue of new matter.
   d. ☐ They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal.
   e. ☐ They present additional claims without cancelling a corresponding number of finally rejected claims.

2. ☐ Newly proposed or amended claims _____ would be allowed if submitted in a separately filed amendment cancelling the non-allowable claims.

3. ☒ Upon the filing of an appeal, the proposed amendment ☒ will be ☐ will not be, entered and the status of the claims in this application would be as follows:

   a. ☐ Claims _____ would be allowable.

   b. ☒ Claims 1 - 6 would not be allowable.

   However: (See attachment for further explanation.)

   (1) ☐ The rejection of claims _____ on references is deemed to be overcome by applicant's response.

   (2) ☐ The rejection of claims _____ on non-reference grounds only is deemed to be overcome by applicant's response.

4. ☐ The affidavit, exhibit or request for reconsideration has been entered but does not overcome the rejection.

5. ☐ The affidavit or exhibit will not be admitted because applicant has not shown good and sufficient reasons why it was not earlier presented.

6. ☐ The application having been examined under the special accelerated examining procedure (M. P. E. P. 708.02), the proposed amendment has not been considered since it does not prima facie place the application in condition for allowance or in better condition for appeal.

Claims 1-6 are deemed properly rejected under 35 USC 101 as drawn to non-statutory subject matter. The U.S. Supreme Court in rendering a decision on the *Dann* v. *Johnston* case, 189 USPQ 257, held the invention to be obvious under 35 USC 103, thus reversing the CCPA. The Court did not render a decision on the 35 USC 101 issue and moreover did not modify its position taken in the *Benson* v. *Gottschalk* case.

In both the *In re Noll* and *In re Chatfield* cases the CCPA reversed the Board of Appeals decision. Until these decisions become final and since further review of clarification may be forthcoming, the PTO is continuing to examine computer program related applications in accordance with its current interpretation of the Supreme Court decision in the *Benson* case.

/s/ Charles E. Atkinson
CHARLES E. ATKINSON
EXAMINER
GROUP ART UNIT 236

APPENDIX E

APPLICATION OF JOHN J. BRADLEY AND BENJAMIN S. FRANKLIN, FILED APRIL 21, 1975, SERIAL NUMBER 570,331, FOR SWITCH SYSTEM BASE MECHANISM.

ABSTRACT OF THE DISCLOSURE

A model-independent instruction in firmware is provided to change, upon execution, information in the system base which is located in both main memory and internal scratch pad registers.

RELATED APPLICATIONS

The following applications are incorporated by reference to the instant application.

* * * * *

15. "System Base", invented by ————————, filed on ————————, and having Serial Number ———— and assigned to the same assignee named herein.

* * * * *

SUMMARY OF THE INVENTION

A model-independent instruction in firmware is provided to change, upon its execution, information in the system base which is located in both main memory and internal scratchpad registers.

The system base located at a location specified by the boundary address register BAR in main memory, is copied into a new location in main memory with predetermined portions of its information changed. This is readily accomplished by the operat-

ing system. (See application incorporated by reference into the application herein). The switch system base instruction then transfers the information which is in the system base at the new location into the system base at the location specified by BAR and also that portion of the system base located in scratch-pad memory.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features which are characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, both as to organization and operation together with further objects and advantages thereof may best be understood by references to the following description taken in conjunction with the drawings in which:

Figure 1 is a block diagram of a multiprogramming system utilizing the invention.

Figure 2 is a schematic representation of various hardware structures utilized by the invention.

Figure 3 is a legend of terms used for reserved areas of storage in registers depicted in Figure 2.

Figure 4 is a schematic diagram of a process control block.

Figure 5 is a schematic diagram of a system for addressing a process control block.

Figure 6 is a schematic diagram of the system base of the invention.

Figure 7A and 7B are a schematic representation of a stack segment and a stack frame respectively.

Figure 8 is a schematic diagram of a system for

addressing G-segments and in particular the queue of processes in the GO segment.

Figure 9 is an exploded schematic diagram of a GO segment illustrating queue of processes and process linking.

Figures 10a through 10L are block diagrams of structures in the PCB.

Figures 11a through 11r are block diagrams of structures in the system base.

Figure 12 is a schematic diagram of addressing schemes of user and system segments utilizing the system base and PCB structures.

Figure 13 is a schematic diagram of the control unit.

Figures 14a through 14i are flow diagrams of the dispatcher unit in firmware.

Figure 15a is a structure of the switch system base instruction.

Figures 15b-15c are flow diagrams of the switch system base instruction in firmware.

DESCRIPTION OF A PREFERRED EMBODIMENT

* * * * *

Control Unit

Referring to Figures 13a-13c details of the control unit are shown. The control unit, although shown separate from the central processing unit (CPU), is in actuality a part of the CPU and is comprised of a control store unit CSU 1301, a control store interface adapter CIA 1302 and appurtenant subunits,

control store loader CSL 1303 and control and load unit CLU 1304.

The control store unit CSU 1301 receives micro-instructions from the control store loader CSL 1303 via the control and load unit CLU 1304 and the control store interface adapter CIA 1302. Under normal operating conditions, microprograms are loaded from an external source during system initialization and become a permanent control function of the machine. However the control store unit CSU 1301 has the ability to be reloaded and initialized in a manner that provides for a variety of central processing unit CPU 1306 operational modes. The following modes of operation of the CPU are available under control of the CSU 1301; (a) native mode; (b) emulation mode; (c) concurrent native and emulation modes; (d) diagnostic mode. This capability is possible because the micro-instructions resident in the CSU are the source of micro-operations used to control the operation of all other CPU functional units such as the emulation unit 1316, the arithmetic logic unit ALU 1317, the instruction fetch unit IFU 1318, the address control unit ACU 1319 and the data management unit DMU 1321. Also shown within the central processing unit CPU 1306 are previously described general register 1307, base registers 1308, scientific registers 1309, T-registers 1310, status registers 1311, instruction counter IC 1312, and hardware control mask register 1313.

Typically the control store unit CSU 1301 is a 9K bipolar integrated circuit programmable read-only

memory (PROM) mixed with read/write random access store (RAM). It has a typical 150 nanosecond read cycle and a 450 nanosecond write cycle. Each location of control store stores one 84-bit micro-instruction word (to be later more fully described), and each micro-instruction word controls one CPU cycle. As each location of the control store of the control store unit CSU 1301 is read, its contents are decoded by micro-operation decoders which provide micro-operation control signals each of which causes a specific operation within the CPU to take place (to be later described in detail).

* * * *

AMENDMENT, AUGUST 11, 1976.

August 10, 1976

Commissioner of Patents & Trademarks
Washington
District of Columbia 20231

Dear Sir:

Responsive to the Office Action of 3/12/76 the due date of which was extended two months from 6/12/76 to and including 8/12/76, please amend the above-identified application as follows:

IN THE SPECIFICATION

* * * *

Page 3, line 21, after "invented by" insert—Claude Carre—.

Page 3, line 23, before ", and having" insert—December 2, 1974—.

Page 3, line 22, after "Number" insert—528,951—.

* * * *

Respectfully submitted,

/s/ Nicholas Prasinos
NICHOLAS PRASINOS
Registration No. 24,791
Attorney for Applicants

PRINT OF DRAWING
AS ORIGINALLY FILED

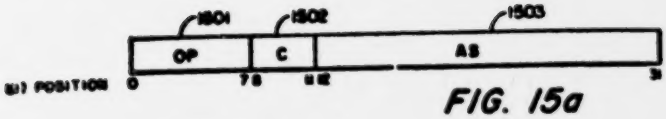

FIG. 15a

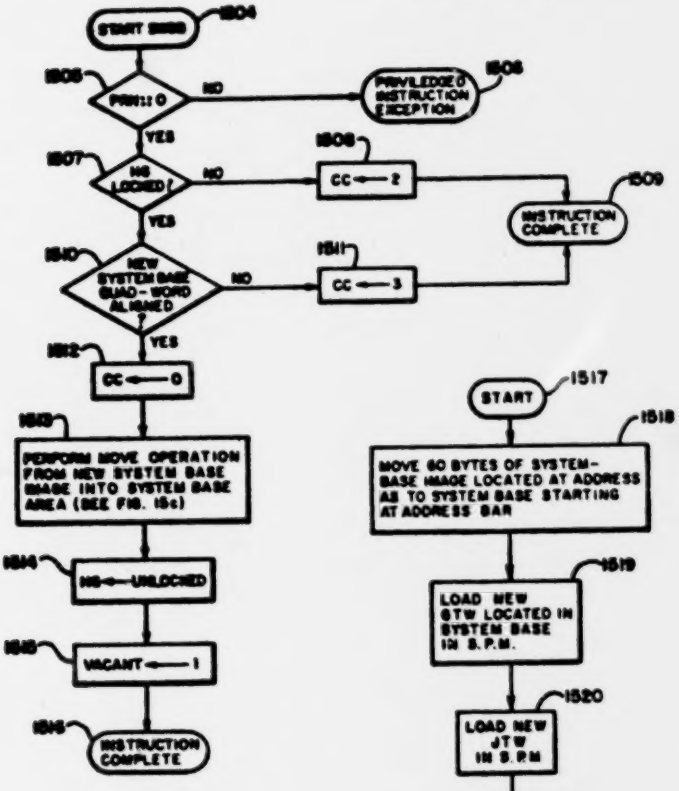

FIG. 15b

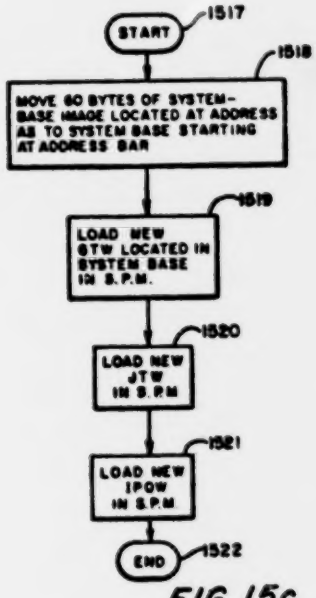

FIG. 15c

REJECTED CLAIMS.

1. In a multiprogramming computer system having a main memory, a central processing unit (CPU) coupled to said main memory, said (CPU) controlling the state of a plurality of groups of processes being in a running, ready, wait or suspended state, said computer system also having scratchpad registers being accessible to an operating system for controlling said multiprogramming computer system, a data structure for storing coded signals for communicating between said processes and said operating system, and said scratchpad registers, said data structure comprising:

(a) first means in said data structure and communicating with said operating system for storing coded signals indicative of an address for a selected one of said processes;

(b) second means in said first means for storing coded signals indicating priority of said selected one of said processes in relation to others of said processes for obtaining control of said CPU when ready;

(c) third means in said data structure and communicating with said operating system, for storing coded signals indicative of an address for a selected one of said plurality of groups of processes, and,

(d) fourth means coupled to said data structure and said scratchpad registers, for generating signals causing the changing of information in said date structure and said scratchpad registers.

2. In combination with a communication center located in a predetermined area of a computer main

memory the computer having a central processing unit (CPU) for executing plurality of processes that compete with each other for control of said CPU, operating system means coupled for providing information to said communication center, and a scratch pad memory in said CPU which stores, under control of said operating system means, portions of information located in said communication center, an improved system controlled by one of said processes for changing information in said communication area and in said scratchpad memory, said improvement comprising:

(a) first means for generating signals causing the creation of an image of said communication center at another location in said main memory;

(b) second means responsive to said operating system means for generating signals causing a change of the information in said image, resulting in a new image; and,

(s) third means, coupled for being responsive to said first and second means and to one of said processes for generating signals for causing a transfer of the new image to said communication center and to said scratchpad memory.

3. The system as recited in Claim 2 wherein said means is a switch system base instruction in firmware.

4. The system as recited in Claim 3 further including an arithmetic and logic unit having an auxiliary memory said arithmetic and logic unit coupled

for communicating with said first, second and third means.

5. The system as recited in Claim 4 wherein said auxiliary memory includes a hardware gate which has a locked and unlocked state said unlocked state permitting internal interrupts or external exceptions, and said locked state not permitting internal interrupts or external exceptions.

6. The system as recited in Claim 5 wherein said hardware gate is locked by said switch system base instruction when executing and unlocked by said switch system base instruction when it terminates execution.

APPENDIX F

APPLICATION OF CLAUDE CARRE, ET AL., FILED DECEMBER 2, 1974, SERIAL NUMBER 528951, FOR SYSTEM BASE

ABSTRACT OF THE DISCLOSURE

A system base provided a communication channel and interface and a mapping mechanism between the operating system and the firmware/hardware controlled processes in a multiprogramming/multiprocessing environment is disclosed. Processes in the multiprogramming/multiprocessing computer system may be in the running, ready, wait and suspended states. Whereas hardware/firmware control the running, ready, and wait states, the operating system creates and deletes processes within the multiprogramming/multiprocessing computer system. Accordingly a communication system is provided to pass information between operating system and processes and to start and stop related processes efficiently. The system base together with a boundary address register provide an interface and control center for such communication system.

* * * *

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features which are characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, both as to organization and operation together with further objects and advantages thereof may best be understood by references to the following description taken in conjunction with the drawings in which:

Figure 1 is a block diagram of a multiprogramming system utilizing the invention.

Figure 2 is a schematic representation of various hardware structures utilized by the invention.

Figure 3 is a legend of terms used for reserved areas of storage in registers depicted in Figure 2.

Figure 4 is a schematic diagram of a process control block.

Figure 5 is a schematic diagram of a system for addressing a process control block.

Figure 6 is a schematic diagram of the system base of the invention.

Figure 7A and 7B are a schematic representation of a stack segment and a stack frame respestively.

Figure 8 is a schematic diagram of a system for addressing G-segments and in particular the queue of processes in the GO segment.

Figure 9 is an exploded schematic diagram of a GO segment illustrating queue of processes and process linking.

Figures 10a through 101 are block diagrams of structures in the PCB.

Figures 11a through 11r are block diagrams of structures in the system base.

Figure 12 is a schematic diagram of addressing schemes of user and system segments utilizing the system base and PCB structures.

Figure 13 is a schematic diagram of the control unit.

Figures 14a through 14i are flow diagrams of the dispatcher unit in firmware.

* * * *

[SEAL]

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Patent Office

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Washington, D.C. 20231

Please Refer To The Following:

Group Art Unit—237
Applicant(s)—Claude Carre et al
Serial Number—528951 Filing Date 12/2/74
Title—System Base

Fred Jacob
Honeywell Info. Systems Inc.
200 Smith St.
Waltham, Mass. 02154

[Mailed Aug. 17, 1978, Group 230]

NOTIFICATION RE APPEAL

* * * *

2. ☒ The appeal in this application is DISMISSED because:
   A. ☐ The $50 fee for filing the Brief as required by 35 U.S.C. 41(a)(6) was not timely filed.
   B. ☒ The Brief was not filed, or was not timely filed (Rule 192(b)).
3. ☒ As the result of the dismissal in "2" above, this application:
   A. ☒ Is abandoned since there are no allowed claims.

* * * *

☆ U. S. GOVERNMENT PRINTING OFFICE: 1979 305885 142